

IN THE CLAIMS:

The text of all pending claims are set forth below. Cancelled claims are indicated with claim number and status only. The claims as listed below show added text with underlining and deleted text with ~~striketrough~~. The status of each claim is indicated with one of (original), (currently amended), (previously presented), (cancelled), (withdrawn), or (new).

There are no claim amendments.

1. (PREVIOUSLY PRESENTED) A robot system having an image processing function for determining orientation, or orientation and position of a robot operation on one of a plurality of objects, the system comprising:
 - a robot;
 - a first image capturing device capturing image data of the plurality of objects containing respective images of the objects;
 - a memory storing reference models, each comprising an image of a reference object captured by said image capturing device in a different direction, and for each reference model storing information of the capturing direction of its associated image and information of an orientation of the robot with respect to the reference object, the information of the capturing direction representing a rotational posture of the reference object relative to the robot, said reference object being one of the plurality of objects or an object having a shape identical to that of one of the plurality of objects; and
 - a processor to perform matching on the image data containing images of the plurality of objects captured by said first image capturing device with each of said reference models successively to select one object having an image matched with one of said reference models, and to determine orientation, or orientation and position of the robot operation based on the image of the selected one object, based on said one reference model and the information of its associated capturing direction, and based on the information of the orientation of the robot operation with respect to the reference object that is associated with said one reference model.

2. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 1, wherein said reference models are obtained from a part of the image data of the reference object.

3. (ORIGINAL) A robot system having an image processing function according to claim 1, wherein said reference models are obtained by processing the image data of the reference object.

4. (ORIGINAL) A robot system having an image processing function according to claim 1, wherein said first image capturing device comprises a camera for capturing two-dimensional image data.

5. (ORIGINAL) A robot system having an image processing function according to claim 4, wherein said image data of the reference object are captured by said camera from a predetermined distance.

6. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 1, further comprising:

a second image capturing device; wherein
said robot situates said second image data capturing device to have said determined orientation or to have said determined orientation and said determined position with respect to the selected one object, and wherein
said processor processes second image data captured by said second image capturing device to detect position and/or rotational posture of the selected one object with respect to said second image data capturing device.

7. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 1 further comprising:

a second image capturing device for obtaining three-dimensional position; wherein
said robot situates said second image data capturing device to have said determined orientation or to have said determined orientation and said determined position with respect to

the selected one object, so that said second image data capturing device is directed to a characterizing portion of the object; and wherein

said processor detects three-dimensional position and/or posture of the selected one object based on three-dimensional position of said characterizing portion obtained by said second image capturing device.

8. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 6, wherein said first image data capturing device is used as said second image data capturing device.

9. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 6, wherein said second image capturing device comprises a three-dimensional visual sensor of spot-light scanning type capable of measuring distance between the sensor and an object.

10. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 6, wherein said second image data capturing device comprises a structured-light unit for irradiating a structured light on the selected object and capturing an image of the object including the irradiated light on the object.

11. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 7, wherein said robot operation is an operation of picking up the selected one object from the plurality of objects, some of which are overlapped with each other.

12. (PREVIOUSLY PRESENTED) A robot system having an image processing function for determining orientation, or orientation and position of a robot operation on one of a plurality of objects of plural kinds, where the orientation of the operation corresponds to a determined orientation of the one object, where the determined orientation is a rotational posture of the one object, the system comprising:

a robot;

a first image capturing device capturing image data of the plurality of objects containing respective images of the objects;

a memory storing reference models, each comprising images of each of different kinds of reference objects corresponding to images captured by said first image capturing device, and storing indicia of the kinds respectively associated with said reference models, and information of a different orientation of the robot with respect to each of the different images of the reference object of each kind, where the captured information of orientation comprises information of a rotational posture of the reference object relative to the robot, each of said reference objects being one of the kinds of the plurality of objects or having a shape identical thereto; and

a processor to perform matching on the image data containing images of the plurality of objects captured by said first image capturing device with each of said reference models successfully to select one object having an image matched with one of said kinds of the reference models, and to determine orientation, or orientation and position of the robot operation, the determining based on the image of the selected one object, based on said one reference model, based on the indicia of the kind associated with said one reference model and the information of the orientation of the robot operation with respect to the reference object associated with said one reference model of said one kind.

13. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 12, wherein said reference models are obtained from a part of the image data of the reference object.

14. (ORIGINAL) A robot system having an image processing function according to claim 12, wherein said reference models are obtained by processing the image data of the reference object.

15. (ORIGINAL) A robot system having an image processing function according to claim 12, wherein said first image capturing device comprises a camera for capturing two-dimensional image data.

16. (ORIGINAL) A robot system having an image processing function according to claim 15, wherein said image data of the reference object are captured by said camera from a predetermined distance.

17. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 12, further comprising a second image capturing device, wherein said robot situates said second image data capturing device to have said determined orientation or to have said determined orientation and said determined position with respect to the object, and wherein

said processor processes second image data captured by said second image capturing device to detect position and/or posture of the selected one object with respect to said second image data capturing device.

18. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 12, further comprising:

a second image capturing device for obtaining three-dimensional position; wherein said robot situates said second image data capturing device to have said determined orientation or to have said determined orientation and said determined position with respect to the selected one object, so that said second image data capturing device is directed to a characterizing portion of the object; and wherein

said processor detects three-dimensional position and/or posture of the selected one object based on three-dimensional position of said characterizing portion obtained by said second image capturing device.

19. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 17, wherein said first image data capturing device is used as said second image data capturing device.

20. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 17, wherein said second image capturing device comprises a three-dimensional visual sensor of spot-light scanning type capable of measuring distance between

the sensor and an object.

21. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 17, wherein said second image data capturing device comprises a structured-light unit for irradiating a structured light on the selected one object and capturing an image of the object including the irradiated light on the object.

22. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 18, wherein said robot operation is an operation of picking up the selected one object from the plurality of objects, some of which are overlapped with each other.

23. (PREVIOUSLY PRESENTED) A method for automatically determining an arrangement of a workpiece relative to a robot, where the determined arrangement comprises at least rotational posture arrangement of the workpiece relative to the robot, the method comprising:

storing reference images corresponding to images of the workpiece or an object so shaped (workpiece/object) and reference arrangement information indicating arrangements of the robot and workpiece/object relative to each other when the images were captured, the reference arrangements comprising rotational arrangements of the workpiece relative to the robot;

from a known arrangement of the robot, capturing a working image of the workpiece among a plurality of randomly arranged workpieces with an imaging device;

finding one of the reference images that matches the workpiece in the working image; and

determining an arrangement of the robot relative to the workpiece based on information indicating the known arrangement of the robot, and based on the reference arrangement information corresponding to the found reference image, where the determined arrangement comprises rotational arrangement of the workpiece relative to the robot.

24. (PREVIOUSLY PRESENTED) A method according to claim 23, wherein reference images and reference arrangement information is obtained for workpieces/objects of different

shapes, and wherein the finding comprises first determining that a reference image of one of the different shapes matches the working image of the workpiece, and then finding one reference image of the shape that best matches the working image.

25. (PREVIOUSLY PRESENTED) A method according to claim 23, wherein the robot is used to capture the reference images, and wherein the reference arrangement information represents arrangements of the robot when capturing the reference images.

26. (PREVIOUSLY PRESENTED) A method according to claim 23, wherein a second imaging device is affixed to the robot and is used to determine additional arrangement information used to determine the known arrangement of the robot relative to the workpiece.

27. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 7, wherein said first image data capturing device is used as said second image data capturing device.

28. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 7, wherein said second image capturing device comprises a three-dimensional visual sensor of spot-light scanning type capable of measuring distance between the sensor and an object.

29. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 7, wherein said second image data capturing device comprises a structured-light unit for irradiating a structured light on an object and capturing an image of the object including the irradiated light on the object.

30. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 18, wherein said first image data capturing device is used as said second image data capturing device.

31. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 18, wherein said second image capturing device comprises a three-dimensional visual sensor of spot-light scanning type capable of measuring distance between the sensor and an object.

32. (PREVIOUSLY PRESENTED) A robot system having an image processing function according to claim 18, wherein said second image data capturing device comprises a structured-light unit for irradiating a structured light on an object and capturing an image of the object including the irradiated light on the object.